D0 Run II Farms

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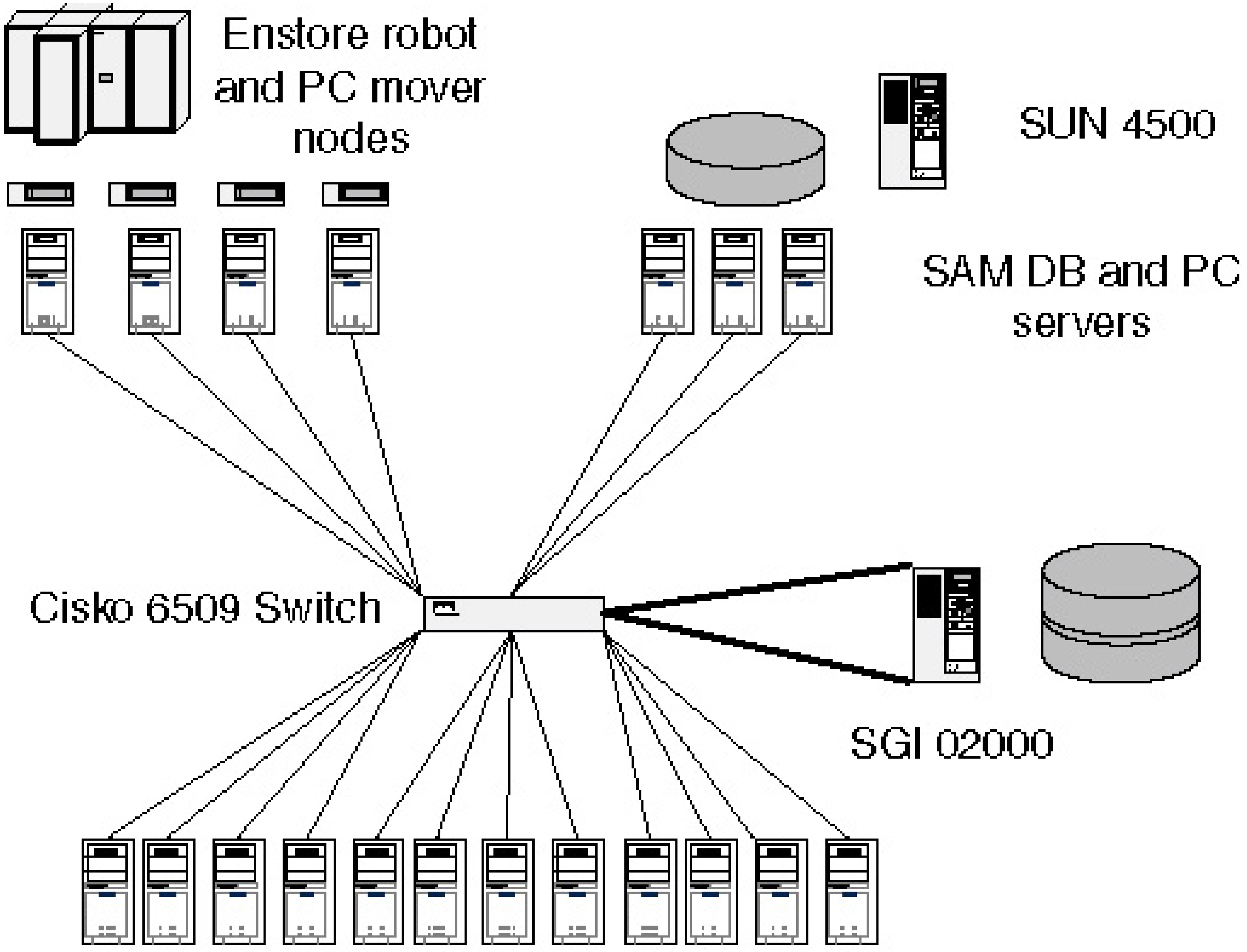
DO Farm needs

- 250K event size
- 50Hz trigger rate
  - peak rate of 12.5 MB/sec
  - DC is less but reprocessing will bring back up
- Reconstruction 5- 10 seconds/event on 500 MHz PIII
  - need 250-500 CPU's to handle peak rate
  - DC is 40% of peak
  - time constant for 1 GB file is 5- 10 hours.



Enstore robot and PC mover nodes

SUN 4500

SAM DB and PC servers

Cisko 6509 Switch

SGI 02000

50 Dual PC worker nodes

I/O machine

- Purpose
  - split/merge of farm output
  - Serve home areas
  - Batch system control
  - File delivery master
- D0bbin
  - 4 CPU SGI 02000
  - 2 GB ethernet cards
  - 4 72 GB disk partitions (2 way stripe)
  - peak I/O rates of 40-60 MB/sec

Worker Nodes

- Dual Pentium III 500MHz
- 256MB/CPU
- 2 data disks (18 GB) + 6GB system
- Fast ethernet
- CD/floppy for system configuration

Design Principles

- Use existing facilities
  - SAM/Enstore for data access and file tracking
  - Farm batch system (FBS) for most job control
- Keep D0 farm control scripts to a minimum
  - Batch system assigns machines
  - Data access system decides which file you get
- If worker process or machine dies, lose minimal number of files and don't affect other processes
- No heroic recovery measures, track and resubmit those files

Worker Configuration

- Workers act as generic FNAL farm machines
  - Only customization is pnfs for file delivery and home area mount
  - D0 environment downloads at job start
  - data access through SAM/encp/rcp, database server

- Batch system assigns workers to job, not D0FARM control process.
- D0FARM control never knows which workers are assigned to a job and does not need to.

Data Access is SAM/enstore

- Integrated data handling system
- File and process data base
- Data base server
- File servers
- Enstore File delivery systems
- Pnfs file system

Farm Perspective

Can tell it you want a set of files

Can ask for the 'next' file

Can flag file as processed or error

Can get detailed accounting on what happened

Major Efforts:

2-3 talks at this conference

SAM # 241

Enstore Talk#176

Farm Batch System
Typical Farm Job

FBS Talk #191

```
SECTION START
    EXEC=startjob  parameters
    QUEUE=D0bbin
SECTION WORKER
    EXEC=runjob  parameters
    NWORKERS=20
    QUEUE=D0worker
SECTION END
    EXEC=stopjob parameters
    QUEUE=D0bbin
    DEPEND WORKER(done)
```

- Queue tells the system what kind of machine to run on and how many.
- EXEC gives the script name and parameters
- DEPEND allows cleanup section to run when all worker sections are done.
- FBS assigns temporary disk on workers
- On end yanks disk and kills all processes.

Start Section

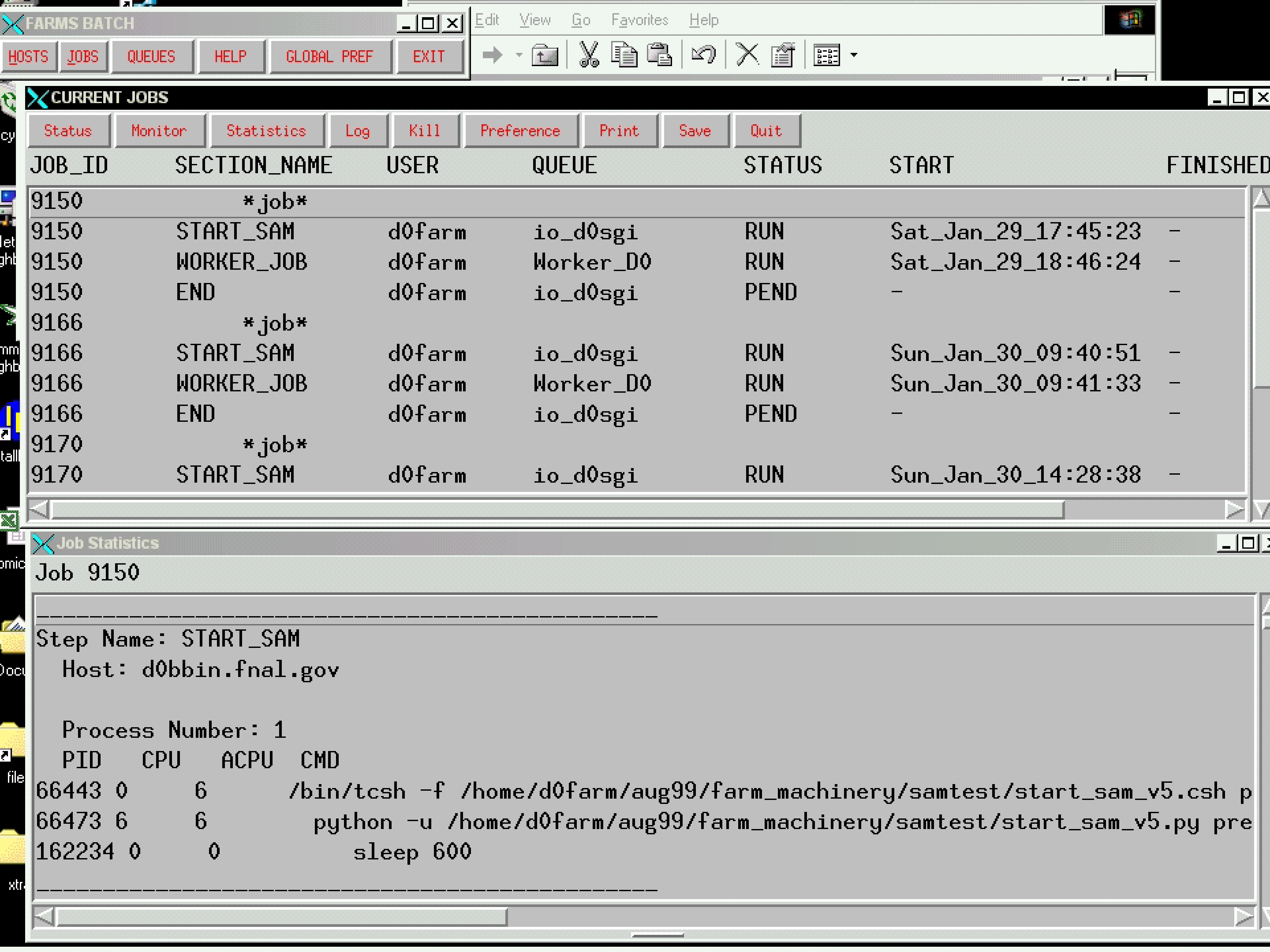
- Set up products and output directories on d0bbin
- Tell SAM which files you will want
- Go into wait state until get end signal

Worker Section

- Download D0 environment
- Start SAM stager
- Ask for next file
- Process file
- Store output file on output buffer
- Inform SAM of success
- Ask for next file
- On error or end of list, terminate.

End Section

- Create job summary
- Send message to Start process telling it to shut down the SAM connection for input
- (Optional) Start file merge/store of output files.



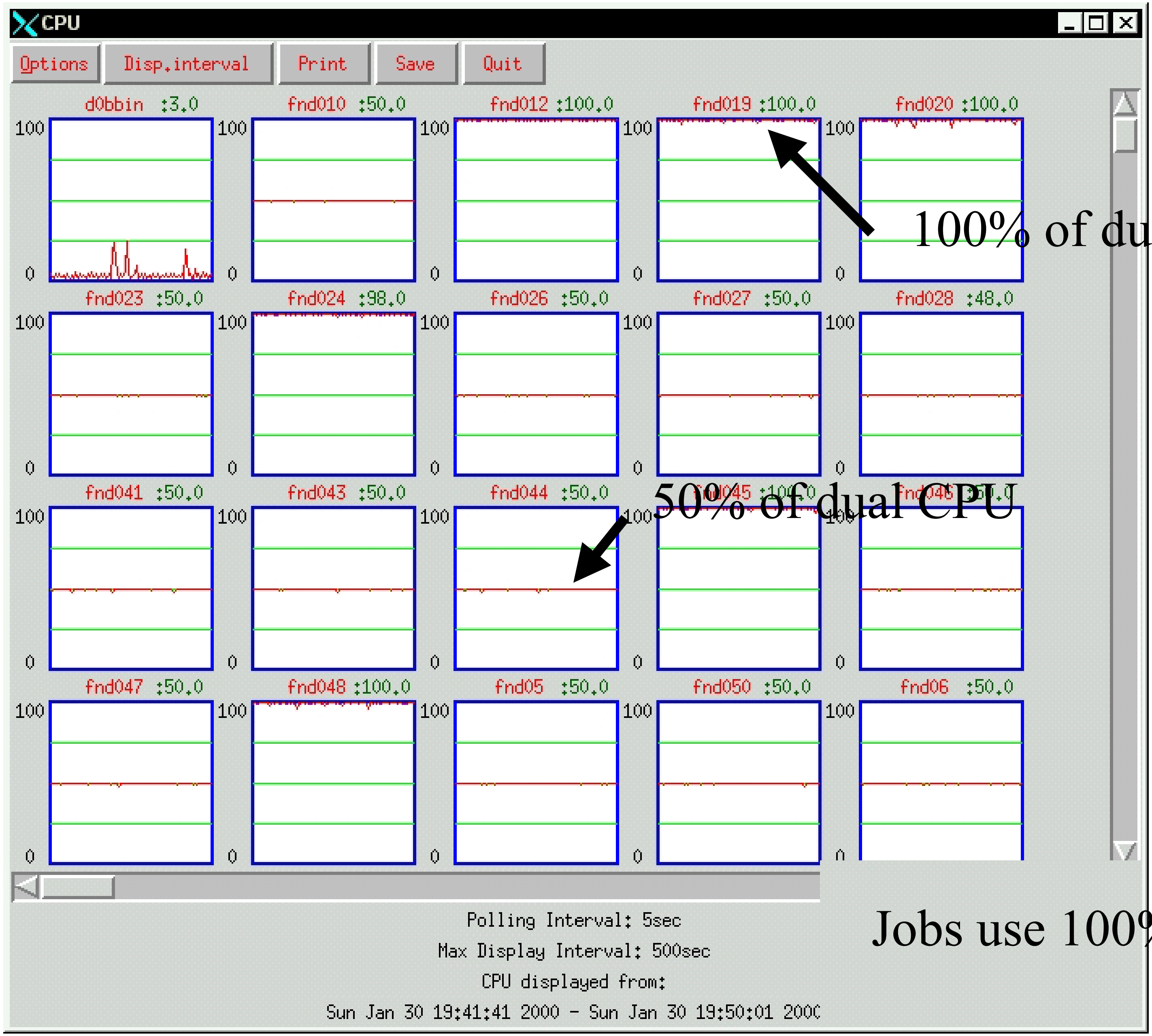
```
JOB_ID     SECTION_NAME    USER       QUEUE           STATUS     START                  FINISHED
9150            *job*
9150       START_SAM       d0farm     io_d0sgi        RUN        Sat_Jan_29_17:45:23    -
9150       WORKER_JOB      d0farm     Worker_D0       RUN        Sat_Jan_29_18:46:24    -
9150       END             d0farm     io_d0sgi        PEND       -                      -
9166            *job*
9166       START_SAM       d0farm     io_d0sgi        RUN        Sun_Jan_30_09:40:51    -
9166       WORKER_JOB      d0farm     Worker_D0       RUN        Sun_Jan_30_09:41:33    -
9166       END             d0farm     io_d0sgi        PEND       -                      -
9170            *job*
9170       START_SAM       d0farm     io_d0sgi        RUN        Sun_Jan_30_14:28:38    -
```

Job 9150

```
-----------------------------------------------
Step Name: START_SAM
  Host: d0bbin.fnal.gov

  Process Number: 1
  PID   CPU   ACPU  CMD
66443 0     6     /bin/tcsh -f /home/d0farm/aug99/farm_machinery/samtest/start_sam_v5.csh p
66473 6     6      python -u /home/d0farm/aug99/farm_machinery/samtest/start_sam_v5.py pre
162234 0     0        sleep 600
-----------------------------------------------
```

Farm Batch System Monitor

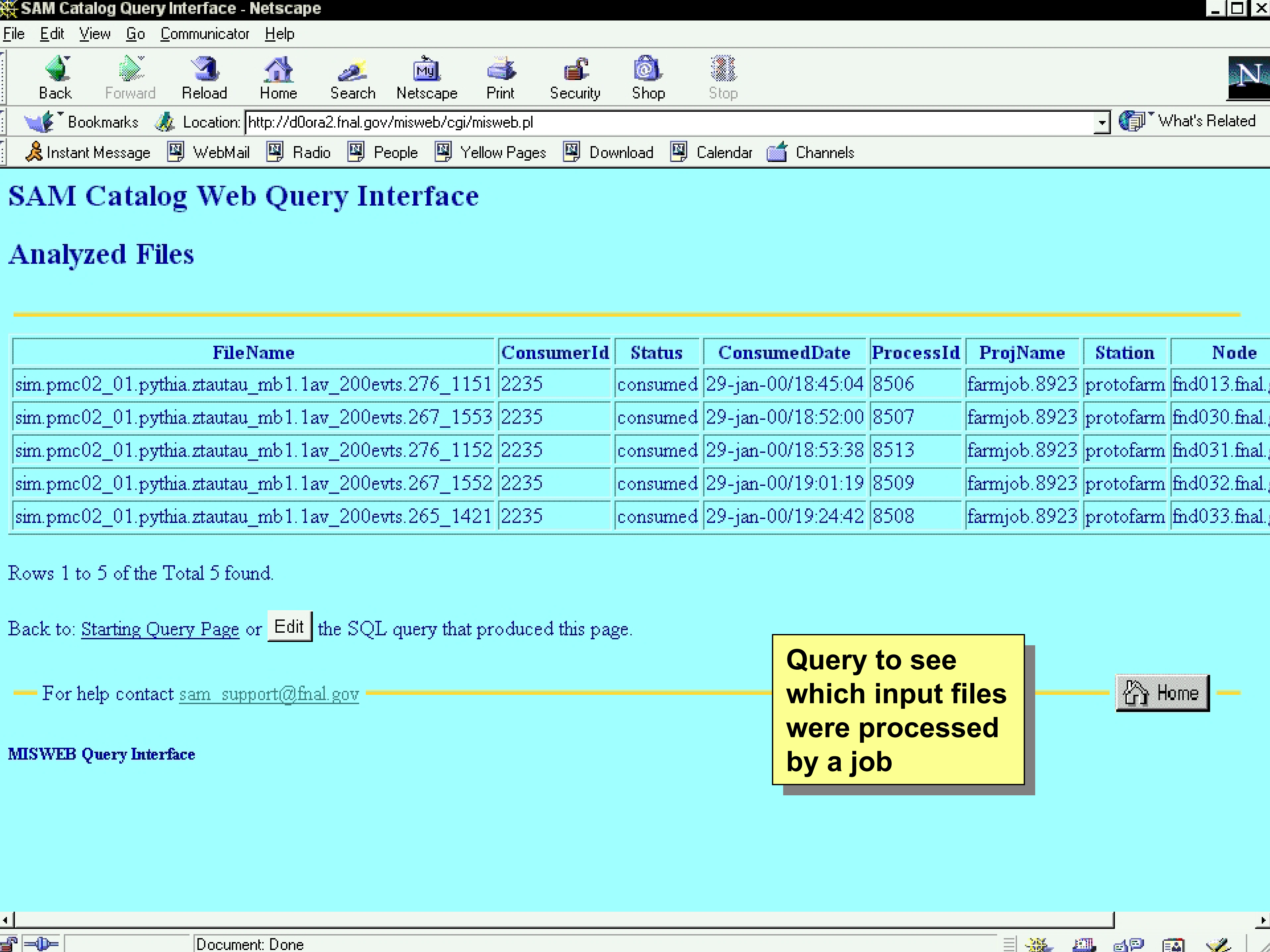


```
Polling Interval: 5sec
Max Display Interval: 500sec
CPU displayed from:
Sun Jan 30 19:41:41 2000 - Sun Jan 30 19:50:01 200C
```

100% of dual

50% of dual CPU

Jobs use 100% of CPU


SAM Catalog Query Interface - Netscape
File Edit View Go Communicator Help
Back Forward Reload Home Search Netscape Print Security Shop Stop
Bookmarks Location: http://d0ora2.fnal.gov/misweb/cgi/misweb.pl
What's Related
Instant Message WebMail Radio People Yellow Pages Download Calendar Channels
Home
Document: Done

SAM Catalog Web Query Interface

Analyzed Files

FileName	ConsumerId	Status	ConsumedDate	ProcessId	ProjName	Station	Node
sim.pmc02_01.pythia.ztautau_mb1.1av_200evts.276_1151	2235	consumed	29-jan-00/18:45:04	8506	farmjob.8923	protofarm	fnd013.fnal.
sim.pmc02_01.pythia.ztautau_mb1.1av_200evts.267_1553	2235	consumed	29-jan-00/18:52:00	8507	farmjob.8923	protofarm	fnd030.fnal.
sim.pmc02_01.pythia.ztautau_mb1.1av_200evts.276_1152	2235	consumed	29-jan-00/18:53:38	8513	farmjob.8923	protofarm	fnd031.fnal.
sim.pmc02_01.pythia.ztautau_mb1.1av_200evts.267_1552	2235	consumed	29-jan-00/19:01:19	8509	farmjob.8923	protofarm	fnd032.fnal.
sim.pmc02_01.pythia.ztautau_mb1.1av_200evts.265_1421	2235	consumed	29-jan-00/19:24:42	8508	farmjob.8923	protofarm	fnd033.fnal.

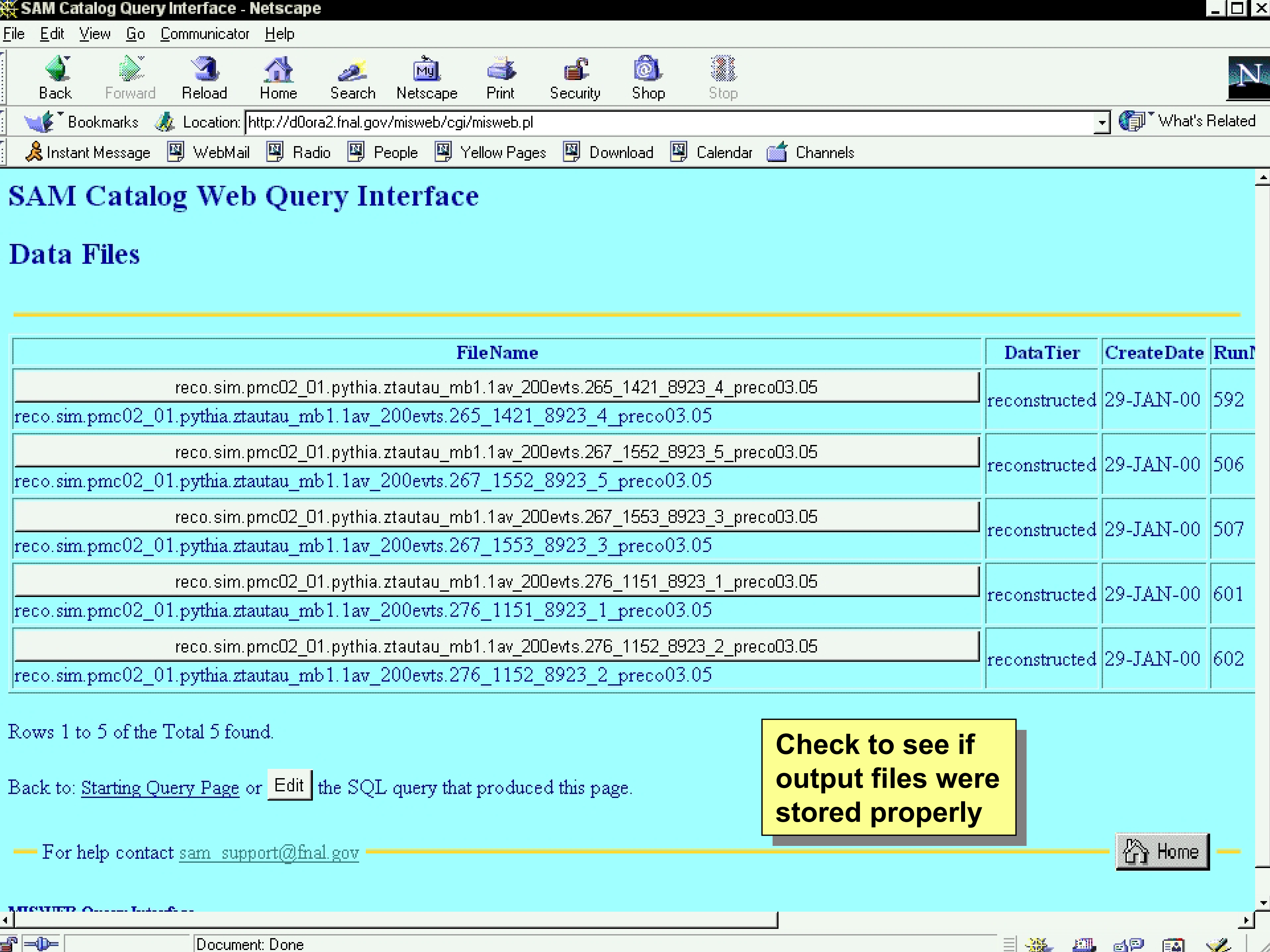
Rows 1 to 5 of the Total 5 found.

Back to: Starting Query Page or Edit the SQL query that produced this page.

For help contact sam_support@fnal.gov

MISWEB Query Interface

Query to see which input files were processed by a job



Location: http://d0ora2.fnal.gov/misweb/cgi/misweb.pl

SAM Catalog Web Query Interface

Data Files

FileName	DataTier	CreateDate	RunN
reco.sim.pmc02_01.pythia.ztautau_mb1.1av_200evts.265_1421_8923_4_preco03.05 reco.sim.pmc02_01.pythia.ztautau_mb1.1av_200evts.265_1421_8923_4_preco03.05	reconstructed	29-JAN-00	592
reco.sim.pmc02_01.pythia.ztautau_mb1.1av_200evts.267_1552_8923_5_preco03.05 reco.sim.pmc02_01.pythia.ztautau_mb1.1av_200evts.267_1552_8923_5_preco03.05	reconstructed	29-JAN-00	506
reco.sim.pmc02_01.pythia.ztautau_mb1.1av_200evts.267_1553_8923_3_preco03.05 reco.sim.pmc02_01.pythia.ztautau_mb1.1av_200evts.267_1553_8923_3_preco03.05	reconstructed	29-JAN-00	507
reco.sim.pmc02_01.pythia.ztautau_mb1.1av_200evts.276_1151_8923_1_preco03.05 reco.sim.pmc02_01.pythia.ztautau_mb1.1av_200evts.276_1151_8923_1_preco03.05	reconstructed	29-JAN-00	601
reco.sim.pmc02_01.pythia.ztautau_mb1.1av_200evts.276_1152_8923_2_preco03.05 reco.sim.pmc02_01.pythia.ztautau_mb1.1av_200evts.276_1152_8923_2_preco03.05	reconstructed	29-JAN-00	602

Rows 1 to 5 of the Total 5 found.

Back to: Starting Query Page or Edit the SQL query that produced this page.

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MISWEB Query Interface

Check to see if output files were stored properly

Results of typical farm test

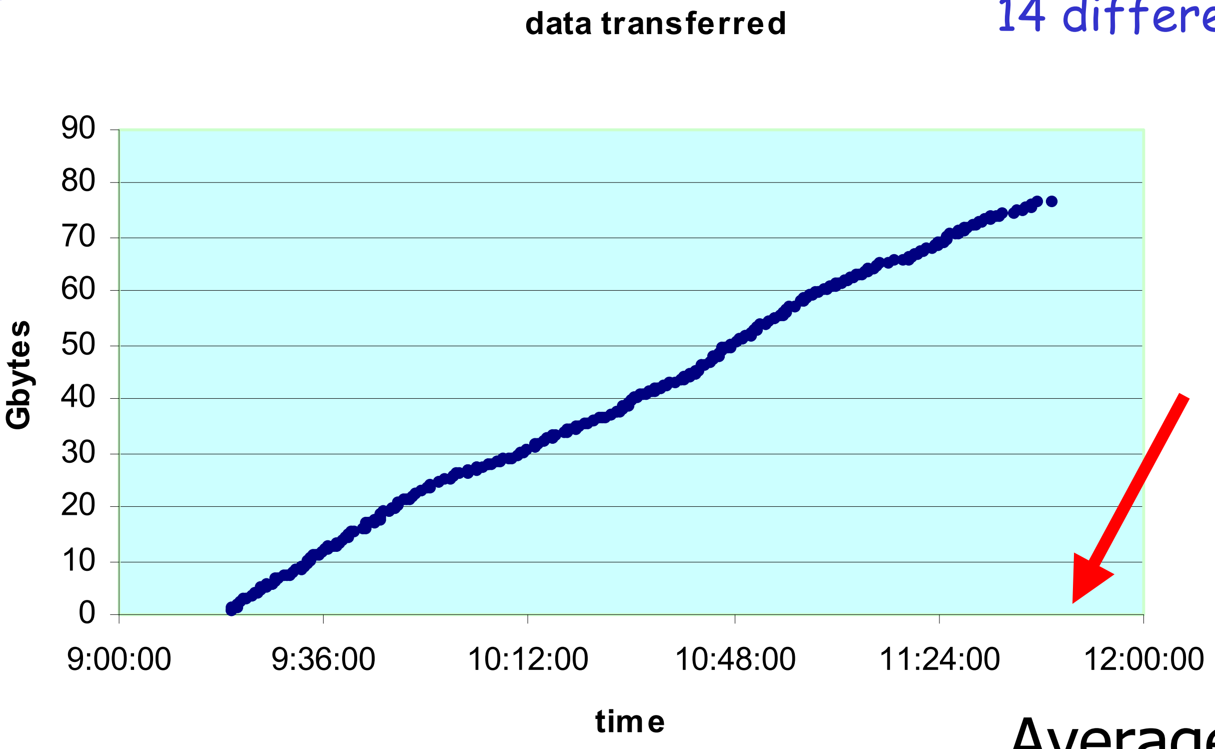
- Create 4 jobs with 25-180 files in each (350 total)
- Submit 4 jobs to the farms using 10-30 workers each (occupy 95/100)
- Process those files through official reconstruction executable
- Files are 200-700 MB Monte Carlo, take 2-10 hours to process.
- 14 tapes read by 5 tape drives (3MB/sec max/drive)
- Output written to I/O node for later dump to tape
- This is almost* equivalent to starting a production 100 processor farm from a cold start.

*exception is tape drive speed -> 12MB/sec, did not do output to tape

Data transfer to workers

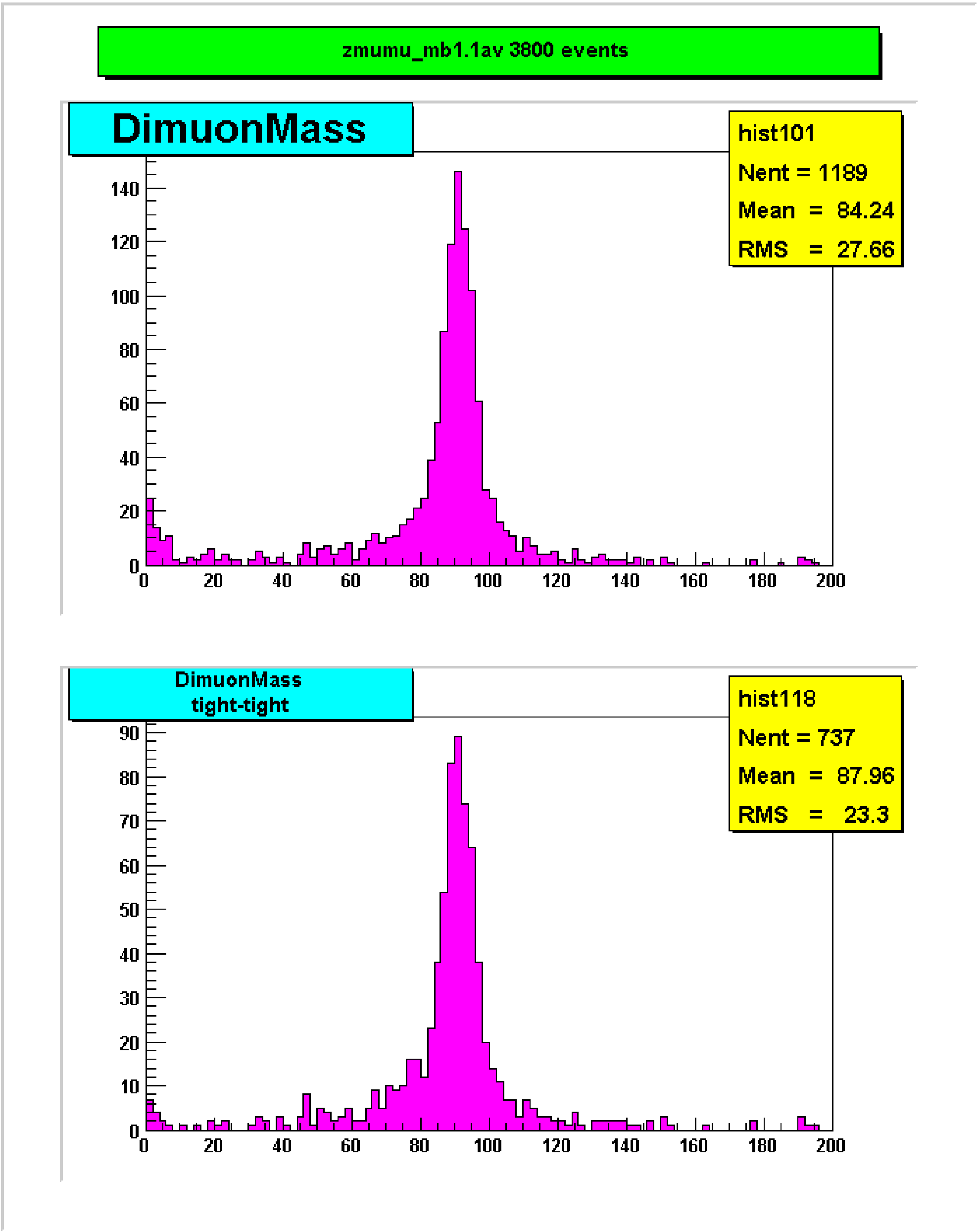
Fire up 4 jobs
Zee, zmumu, ttbar
Qcdpt>80

322 files
95 worker CPU
5 tape drives
14 different tapes



All files on workers

Average transfer rate
9.5 MB/sec
Peak ~ 15 MB/sec



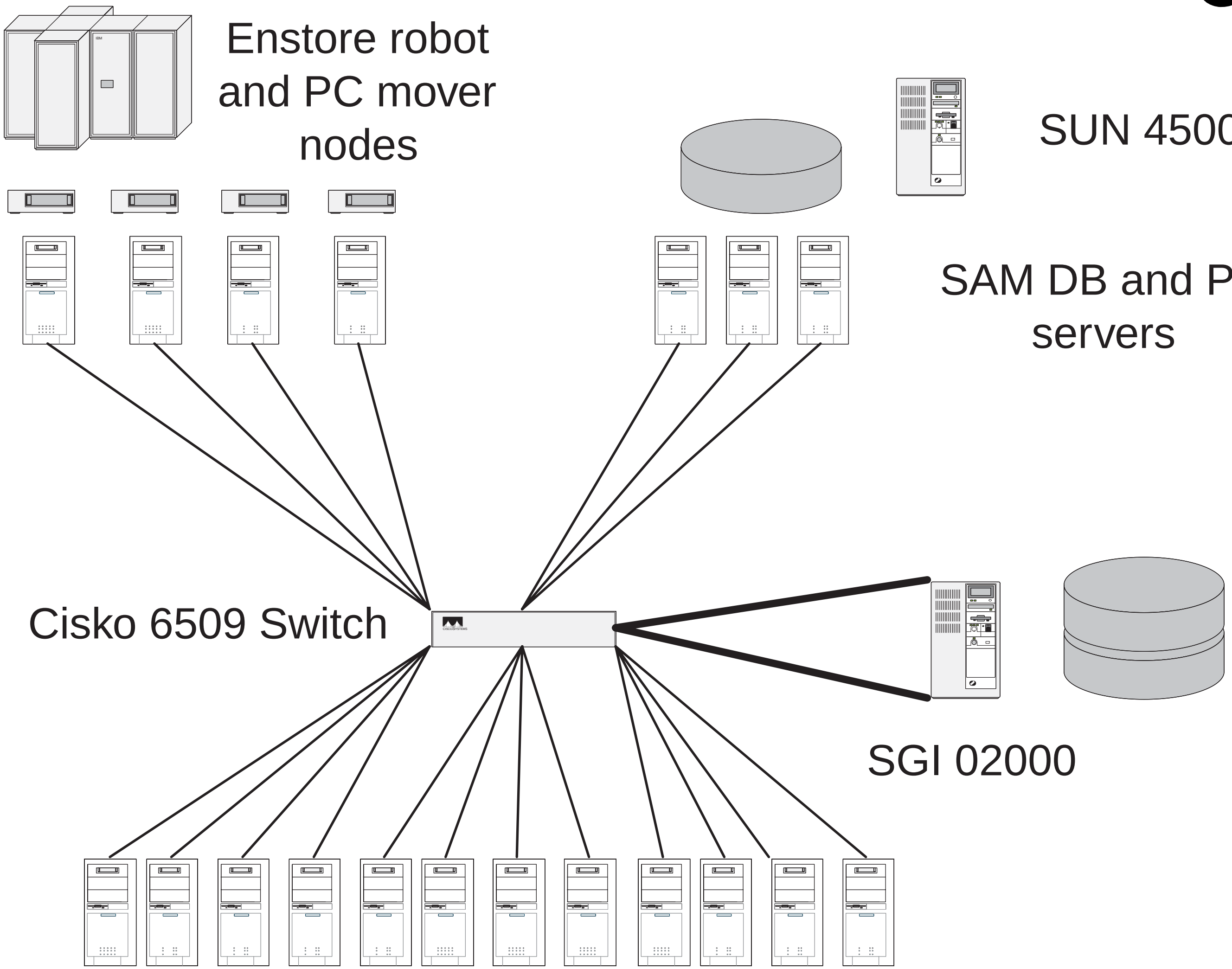
Studies done with output of test – muon id validation

Results

- Farm system used to debug production executable
  - 8 different causes of crashes found in ~100,000 events
- Improved executable now being used to process 400,000 Monte Carlo events
- FBS/SAM can process data at full rate on 100 processors.
  - System can be scaled by cloning
- Recovery mechanism reasonably robust
- Database can easily track and resubmit failed files.

Future

- Stop worrying if the farm hardware works, it does
- Use what we learned from first test to optimize submission scripts and file tracking
- Implement file merging on output machine
- Keep testing
- Wait for data



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